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CHAPTER NINE: CONCRETE BARRIERS

The concrete median barrier and the temporary concrete barrier are the two types of concrete barriers used. A concrete median barrier is used for safety by separating traffic traveling in opposite directions, traveling in the same direction, and by redirecting errant vehicles. The concrete median barrier is a permanent barrier. Temporary concrete barriers may be used as a median barrier for a temporary situation or may be used to protect traffic from a temporary construction hazard as in bridge repairs.

Concrete barriers are either cast in place or precast. Both types are discussed in this chapter.

Standard Sheets **602-CCMB-01** & **04** contain the dimensional and other requirements for concrete median barriers. Standard Sheet **801-TCCB-01** contains the dimensional and other requirements for temporary concrete barrier.

Figure 9-1. Slipforming a Concrete Barrier

GRADE PREPARATION

Grade preparation for the concrete median barrier is the same for cast in place or precast. The excavation is made to the required depth and width for the barrier and compacted to a firm even surface. All soft and unsuitable material is required to be replaced with acceptable material and thoroughly compacted.

PRECAST CONCRETE MEDIAN BARRIERS

Precast concrete median barriers are normally produced in a casting yard or a concrete plant. After casting and final inspection, they are shipped to the job-site and set in place.

Precast units may be 10 ft to 20 ft in length. Whatever length is selected, the length is required to not vary throughout the contract except at special situations such as inlets or bridge abutments. Many special situations require that a small section of barrier be cast in place.

Standard Sheets **602-CCMB-01** & **04** should be consulted for the proper cross-sectional dimensions.

FORMS

The forms used for precast concrete median barriers are generally made of steel and are required to be unyielding, mortar tight, and of sufficient rigidity to prevent distortion. The forms are designed so that the finished product conforms to the required dimensions and contours. All sharp corners are required to be chamfered.

Prior to placing the concrete, the interior of the forms are coated with paraffin oil or other approved coating. Lubricating oils, fuel oils, or kerosene are not allowed because these materials discolor the concrete. Immediately after the forms are stripped, the forms are thoroughly cleaned.

CONCRETE COMPOSITION

The composition of the concrete for precast concrete median barrier is different than the concrete mixes previously discussed.

The following is a list of materials used in precast concrete construction:

1) Portland Cement
2) Fly Ash (optional)
3) Fine Aggregate, Size No. 23
4) Coarse Aggregate, Class A, Size No. 91
5) Air Entraining Admixture
6) Water Reducing / Retarding Admixtures
7) Water

The main difference of this concrete is the requirement of No.91 coarse aggregate.

The mix design is the responsibility of the Supplier. The Specifications require that the mix be capable of attaining a minimum 28 day compressive strength of 3000 lb/in^2. This strength is determined by breaking cylinders made by the technician as the concrete is placed in the forms. No concrete barrier may be shipped until this strength is obtained.

Since acceptance of the concrete is based on cylinders, yield tests are not taken. The slump requirement for precast concrete is 2 to 5 in. The required air content is 5 to 8%.

PLACING AND FINISHING CONCRETE

Concrete is placed in the forms in such a manner that there is no more than 5 ft of free fall and that no segregation occurs. The concrete is placed in uniform layers and vibrated during and after placement.

Immediately after removing the forms, fins and irregular projections are removed from all exposed surfaces. All holes, honeycomb spots, cavities, broken corners or edges, and other defects are required to be thoroughly cleaned and saturated with water. The concrete is carefully pointed and trued with fresh mortar within 30 minutes of removal of the forms.

REMOVAL OF FORMS AND CURING

Side forms may be removed when no distortion, slump, or misalignment of the concrete occurs. The barrier is required to remain supported on the bottom until the concrete has reached a strength of at least 2000 lb/in^2 determined from the test cylinders.

Immediately upon removing forms, the technician inspects the barriers for defects and the barriers are repaired, if required.

Curing is required until the ultimate strength is achieved. Curing may be achieved by covering all exposed surfaces with two layers of wet burlap or steam curing. When wet burlap is used, the burlap is required to be kept wet by automatic means. Steam curing is used in a controlled environment to speed up the curing process. Section **707** lists the procedures for steam curing and other accelerated curing methods. Liquid curing compound may be used only when a rubbed finish or sealer is not specified.

HANDLING AND SHIPPING

Unless otherwise approved, precast barriers are required to be handled with a suitable hoisting device provided with a spreader sling. This sling prevents horizontal forces from being produced in the member due to lifting.

To avoid damage to the concrete barriers during handling, storing and transportation, the barriers are required to remain in an upright position at all times and be lifted by the inserts or other approved devices.

During transportation, the barriers are supported with truck bolsters or battens no less than 4 in. wide and padded with 1/2 in. of rubber. Wood blocks are placed under all tie chains to prevent chipping of the concrete.

PLACEMENT OF PRECAST UNITS

Of major importance during placement of concrete barrier units is to assure that the requirements for horizontal and vertical alignment are met. Horizontal and vertical alignment of adjacent units may not exceed 1/4 in. across joints as measured from a 10 ft straightedge.

TESTING AND INSPECTION REQUIREMENTS

Testing of concrete used in precast units is different than other concrete because of the flexibility the precast manufacture is allowed in the concrete mix design. Only air content, slump, and cylinder strength is tested.

The air content requirement for precast median barriers is 5 to 8% and the slump requirement is from 2 to 5 in. The technician is required to make a minimum of five cylinders to determine the strength during a concrete pour. These cylinders are cured for up to 28 days and then tested to determine the ultimate strength. Once the concrete strength reaches 3000 lb/in^2, which could be in as little as two or three days or as much as 28 days depending on the concrete mix design used, the barriers may be accepted and shipped to the job-site.

All testing of materials is required to be in accordance with the Frequency Manual, and all materials are verified as acceptable materials for use. All required basis for use documents are obtained for the material records.

All items are measured and documented for payment on a daily basis. These measurements are required to be accurate enough for final payment so that additional measurements at a later date are not required.

CAST - IN - PLACE CONCRETE MEDIAN BARRIERS

Cast-in-place concrete median barriers are dimensionally similar to precast concrete median barriers; however, the forms are set at the exact location of the finished product. The testing requirements and basis for use is different than that required for precast barriers.

FORMS

Requirements for forms for concrete median barriers are much the same as for curbs. These forms are generally made of wood or steel and are in 8-10 ft sections. Forms are required to be cleaned and oiled before use. Wooden forms are inspected often between pours as they tend to wear out quickly and may need to be repaired or replaced often.

Vertical and horizontal alignment is vital to the appearance of the barrier. The Specifications require that the surfaces of the concrete vary by no more than 1/4 in. in 10 ft. This tolerance may easily be achieved if the forms are set true and straight.

When pouring barriers in conventional wood or metal forms, the force of the concrete and the vibration tends to push the forms up from the ground. For this reason, forms are required to be tied to the grade either by a combination of stakes, braces, or weights before the pour.

CONCRETE COMPOSITION, PLACEMENT, AND FINISHING

Unless otherwise specified, concrete used in cast-in-place concrete median barriers is required to be class A concrete in accordance with Section **702**. Concrete is placed in the forms in at least two layers, each layer being vibrated as the concrete is being poured.

The top of the barrier is finished with a hand trowel, and the edges are chamfered or beveled (Figure 9-2). Immediately following the removal of the forms, all fins and irregular projections are required to be removed from all exposed surfaces. All cavities and holes from form ties and honeycomb spots, broken corners or edges, and other defects are required to be thoroughly cleaned, saturated with water, and carefully pointed and trued with mortar (Figure 9-3).

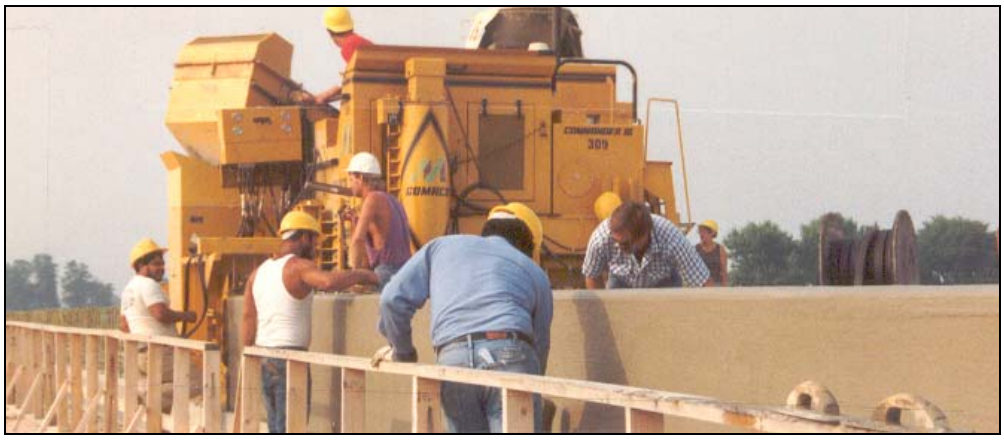

Figure 9-2. Hand Finishing Concrete Barrier

Unacceptable Cracks in Barrier

Figure 9-5. Concrete Barrier Repair

If the barrier is being slip-formed, the concrete is placed into the slip-form machines conveyor or auger and placed into the form. The slip-form machine (Figure 9-4) has vibrators to consolidate the concrete as the material enters the forms. If properly done, very little hand finishing should be required. The final finish on a slip-form barrier may be an approved brush finish.

Figure 9-2. Slipform Machine

JOINTS

Standard Sheets **602-CCMB-01** & **02** show the various types of joints that may be required for the construction of cast-in-place concrete median barriers.

An expansion joint type A is required 5 ft before and after an inlet and 10 ft away from any bridge piers or bents. There may be no more than 400 ft between type A joints.

A type B joint is sawed into the barrier to a depth of 1 1/2 in. and at intervals no greater than 20 ft.

Figure 9-6. Sawing Concrete Joints

SEALING

If the barrier is placed next to a concrete pavement or base, a double application of curing compound is required to be placed next to the pavement or base before the barrier is poured. A single application may be applied at a minimum rate of 1 gal/75 ft^2.

Regardless of the method of construction, all exposed surfaces of the concrete median barrier are required to be sealed with a clear sealer. The sealers that may be used are included on the Approved List of Proprietary Portland Cement Concrete Sealers as clear sealers. The time of application, the rate of application, and temperature requirements are listed on the Approved List for the particular sealer used.

Before application of the sealer, the surface of the median barrier is required to be thoroughly cleaned by sandblasting. Final cleaning is done with compressed air free of water, grease, or other foreign substances.

REFLECTORIZATION

All concrete median barrier are required to be reflectorized with wide angle reflectors as shown on the plans. These reflectors are glued to the barrier with a mastic.

The reflectors used are either white or yellow. The white reflector is always used to the right of the traffic and the yellow reflector is always used to the left of the traffic.

CONSTRUCTION AND INSPECTION PROCEDURES

Placement of cast-in-place concrete median barrier by the slip-form method is required to have straightedge requirements of 1/4 in. in 10 ft. If the tolerance is not being met, the operation is stopped before an excessive amount of median barrier is placed that would have to be removed.

All on-site testing of materials is done in accordance with the Frequency Manual. Materials used are tested and verified that they are approved for use. The required basis for use documents are obtained for the material records.

All items for payment are measured and documented on a daily basis. These measurements are required to be accurate enough for final payment so that additional measurements at a later date are not required.

TEMPORARY CONCRETE BARRIERS

Temporary concrete barriers are precast in a manner similar to precast concrete median barriers and are fabricated with the same strength and straight-edge requirements.

PLACEMENT AND ANCHORING

Temporary concrete barriers are located as shown on the plans or as directed. Anchoring of the barriers is required where little or no movement of the barrier by traffic may be tolerated. These areas are determined from the plans and by the PE/PS. When anchoring is required, the anchoring is done according to the details shown on Standard Sheet **801-TCCB-04.**

DELINEATION

Temporary concrete barriers are delineated with type C construction warning lights and wide angle reflectors as shown on the plans. If the barriers are used to separate two-way traffic, the warning lights are required to have bi-directional lenses so that they serve as a warning to both directions of traffic.

Wide angle reflectors used on temporary barriers are white on the right side of traffic and yellow on the left side.

MEASUREMENT AND PAYMENT

Temporary concrete median barriers are measured and paid for by the linear foot and are paid for only once no matter how many times the barrier is moved to accommodate different phases of construction. Warning lights, wide angle reflectors, and anchoring is all included in the cost of the barriers.

CONSTRUCTION AND INSPECTION PROCEDURES

Temporary concrete barriers are inspected for correct location as shown on the plans, correct anchoring hardware, and anchoring locations and methods. The reflectorization spacing of warning lights and reflectors is also checked. All materials are verified as being approved for use and all required basis for use documents for the material records are required to be obtained.

All items for payment are required to be measured and documented on a daily basis. These measurements are required to be accurate enough for final payment so that additional measurements are not required at a later date.